

Even with a comparatively small range of expansion the steam velocity so

« attained becomes exceedingly high, and calls for a very high speed of revolution for its efficient utilization, and necessitates the use of speed-reduction

§ gearing for most purposes. Such turbines are known as single-stage turbines.

With a view to overcoming the limitations imposed by such high velocities, Dr. Zoelly, of Zurich, and Professor Rateau, of Paris, applied the principle of subdividing the total available pressure drop, and built multi-pressure stage turbines. These consist of a number of discs similar to that used by De Laval, with blades fixed on the periphery. The discs are mounted on a common shaft with diaphragms carrying the nozzles or guide blades placed between.

Other inventors retained the single-pressure stage, but mounted two or more

" rows of blades on the disc with intermediate guide blades which guide the steam from one row of blades to the next without fall of pressure, thus subdividing the steam path into velocity stages. Such turbines have the

advantage of retaining the single wheel, but the efficiency attained does not

j, equal that of a multi-pressure stage turbine.

The original turbine due to Curtis, an American inventor, combined the two methods of subdivision, that is to say, it consisted of a number of pressure stages, each of which in turn consisted of two or more velocity stages.

f Some of the largest turbines are still being built on the single multi-pressure stage principle, but the majority of designs of impulse turbines in

I all countries now take the form of a two-row velocity stage for the first-pressure stage, and simple-pressure stages for all lower stages.

I¹ The introduction of the " velocity compounded wheel " in the first stage

f

means a slight fall in the efficiency, but has the twofold advantage of reducing the number of discs and at the same time allowing a greater drop of pressure

if in the first batch of nozzles with resultant lower steam pressures and temperatures in the turbine housing proper.

Reaction Turbines.—If the expansion of the steam is effected in the moving blades, the mechanical energy is derived from the maintained reaction due to such expansion, and such turbines are known as reaction

turbines. This term is generally applied to all turbines embodying the

reaction principle in all stages, regardless as to whether or not the turbine

contains fixed blades in which the steam is partially expanded before entering the revolving blades. By far the most important type of reaction turbine is that due to Parsons, in which the steam is expanded in both fixed and

moving blades. The only practical turbine in which the whole range of expansion is effected in revolving blades is that designed by Messrs. Ljungstrom. The first turbines built by Parsons, and all subsequent designs on the reaction principle, embodied the multi-pressure stage principle, and it is no doubt due to this feature of the inventor's original designs that they

found a more rapid and more extensive application than those built by his

I contemporary Dr. De Laval, and it is important to note in estimating the value of his invention that the original principles of his turbines have been retained to this day.

The rotor construction of Parsons turbines differs essentially from that

j